Lovett (R.W.)

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BY
ROBERT W. LOVETT, M.D.,
OF BOSTON.

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THE AMBULATORY TREATMENT OF POTT'S DISEASE.

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POTT'S DISEASE is in itself only a tuberculous destruction of the anterior part of the bodies of the vertebræ. No deformity is necessarily attendant upon its occurrence, and the antero-posterior curvature of the spine, with which we always associate it, is really the result of the erect position. It is said that this deformity does not occur in quadrupeds.

The present paper is an attempt to formulate certain problems which are met in the treatment of this affection by ambulatory means. When a surgeon, in starting to treat a case of Pott's disease by ambulatory methods, selects the force of gravity as his antagonist, rather than as his assistant, it is proper that he should appreciate the problem which he is undertaking and understand clearly the mechanical aspect of the case. Instead of keeping the patient with Pott's disease in bed, if the surgeon allows him to go about, so that the heavy weight of the body comes upon the diseased segment of the vertebral column, the surgeon should know pretty definitely whether this is a matter that he can counteract by apparatus, or whether all mechanical support to the spine is not necessarily imperfect. The question is this: Can the spine be placed in as favorable a condition

for recovery as during recumbency, and what is the mechanical value of the methods of ambulatory treatment now in use?

To consider, for example, a case of dorsal Pott's disease in a boy weighing forty pounds, where the disease is located in the lower dorsal vertebræ, say the ninth, tenth, and eleventh. It is manifest that, inasmuch as the vertebral column bears all the body weight, and as the vertebral column is normally convex backward in the dorsal region, the weight of the body above the disease must needs be transmitted through the bodies of the dorsal vertebræ. This weight is the weight of the segment of the body above the diseased vertebræ. It includes the head, with the brain, the neck and its firm muscles, the shoulder girdle, from which hang the arms, which are of no little weight, and the upper part of the chest, with the contained organs. There is no support in front. These organs are hung simply from the backbone, from which the chest girdle runs out just as a crossbar does from a telegraph pole. It is not a bad estimate, I think, to place the weight of these organs which I have just mentioned as half the body weight—in this case twenty pounds. We will assume, then, that the problem in this especial case is to modify, if possible, the pressure which comes from this weight upon the diseased vertebræ, and that this pressure is the result of a twenty-pound superincumbent weight.

The problem which efficient mechanical support must solve is to remove or lessen the weight coming upon the diseased bodies of the vertebræ.

The antero-posterior brace attempts to do this by acting as a lever which shall transfer the weight to the articular and transverse processes by pushing against the deformity as a fulcrum. In other words, it should modify intervertebral

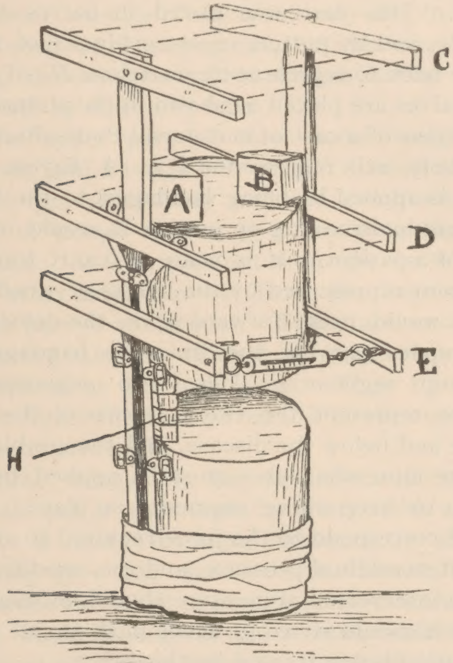

FIG. 1.

pressure. It is upon this theory that the brace was constructed and should be used.

The model which is presented is a very imperfect affair, but one which makes very clear some of the intrinsic difficulties met with in the treat-

ment of Pott's disease. This model was made as follows: A plaster jacket was applied to a patient and removed. After removal, the jacket was bandaged together and filled with plaster-of-paris paste, which hardened into a rough cast of the trunk. This cast was sawed in halves transversely, and by putting in some blocks of wood at the back to represent the vertebræ *H*—if these two halves are placed as shown in the picture, the conditions of a case of mid-dorsal Pott's disease—are fairly well represented (1). A Taylor back brace is applied by being bandaged to the lower segment and running up just as it would in the case of a patient. It is made to exert force at the point represented by the blocks of wood just as it would press forward upon the deformity. The upper part of the brace is bandaged to the top segment. These two segments of plaster represent the two segments of the body above and below the disease, and the problem is to determine what force must be applied by the brace to keep these segments in place. This would correspond to the force required to modify the intervertebral pressure, and this modification of the intervertebral pressure should be what the surgeon should strive to accomplish in all cases of Pott's disease treated by this brace.

The criticism may be made that this model does not reproduce the muscles. The only muscles which come in question are the intrinsic muscles of the spine, and those work to such a very great disadvantage in comparison with the leverage that the weight obtains, that they may be disre-

garded as of practically little importance. They could have been represented by rubber cords running along the back of this model, but it is evident that such apparatus would have very little practical influence upon the experiment. The posterior muscles of the trunk may tilt the body backward, as often happens, but this acts only to bring the superincumbent weight further back, and will be discussed later.

The upper part of this model weighs ten pounds, and a ten-pound weight is attached to it, which represents fairly well the conditions in a case of dorsal disease in a boy weighing forty pounds. An arm runs out from the back brace and other arms run out from the front of the upper part of the model. These are connected by spring balances, which show how much pressure is required at different levels. They show how much force will be required to hold the upper part of the model back.

Three things can be demonstrated by this model: (1) If the chest is firmly held, and the pelvis is held with equal firmness, the pressure coming upon the spine over the disease, in case the brace were used to modify intervertebral pressure, would be so great that no skin would be able to stand it. If the finger is placed between the back brace and the wooden blocks in the model which represent the diseased column, it will be found that even when the upper segment only weighs twenty pounds the pressure cannot be borne. It simply demonstrates the necessarily incomplete action of the brace, for if it were pos-

sible for the pelvis and chest to be held as firmly to the brace in the living subject as in this model, the skin would not be able to stand the pressure. It is obvious that the pelvis and chest cannot be held as firmly as in this model. (2) The position of the superincumbent weight is a most important matter. If the ten-pound weight is placed at *A*, that is as far back as possible, the spring balance at *D* registers ten pounds. If, however, the weight is placed at the forward part of the model, *B*, the balance registers nearly twenty pounds, demonstrating that the position of the superincumbent weight (that is, of the head and shoulders) is a most important matter in determining the amount of weight to come upon the diseased vertebræ. Therefore, if the head and shoulders are held as far back as possible in this way, it requires much less pressure to make the brace efficient than when the head and shoulders droop forward. (3) The level at which the backward pull is applied is a most important matter. In this experiment the spring balances are adjusted at the level of the axillæ, *D*, and the transverse pull is made practically at the level where would come the highest transverse straps of the apron. If the pull is made at a lower level in the model *E*, so great an amount of force is required to hold the upper part of the model in place that it cannot be registered by the balances in use. If the two arms are prolonged up to what would perhaps be the level of the middle of the face, *C*, much less force is required to hold the upper segment of the model in place than when pressure is made back-

ward at the axillary line; that is, the higher the backward pressure is applied the less force is required to hold the upper part of the model in place.

This model is not presented as an accurate reproduction of the mechanical conditions in Pott's disease, but to demonstrate certain obvious facts.

The practical application of this experiment is as follows: In the living subject it is not possible to obtain a sufficiently firm hold upon the chest and pelvis. If it were, the skin over the deformity would not be able to stand the force required to modify intervertebral pressure. The Taylor back brace as ordinarily applied exerts no backward pull above the axillary line, where a very great force would be required to pull the upper segment of the body backward (Fig. 2). The chest piece of Dr. Taylor, which applies backward pressure in the fossæ under the clavicles, is in the right direction. The apparatus of Dr. Whitman (Fig. 3), which makes pressure upon the anterior part of the shoulders, is also in the right direction, but incomplete and incapable of exerting proper pressure. If a firm hold could be obtained upon the chest, a brace would be able to accomplish much more than is found to be the case now. The chest piece used by the writer, which is practically an anterior brace to the chest, is shown in the diagram. It is an effort in the direction of obtaining this hold upon the chest, and is partly satisfactory.

With regard to the mechanical efficiency of the plaster-of-paris jacket in Pott's disease, a different method of experiment was undertaken. If the

plaster jacket diminishes the deformity, or extends the spine when applied, it must necessarily cause lengthening of the body. If the plaster jacket can accomplish as much, or nearly as much as is done

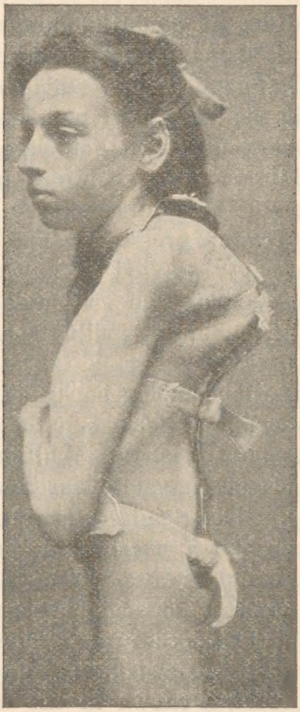

FIG. 2.

by having the child lie on its back, the length of the child should be as much after the application of the plaster jacket, as when lying down. Some preliminary experiments were made with regard

to the effect of recumbency in increasing the length of children with Pott's disease. (1) A boy with lumbar deformity was one-quarter of an inch longer when lying down. (2) A girl with dorsal deformity was one-half of an inch longer when lying down. (3) A girl with lumbar deformity was one-quarter of an inch longer when lying down. (4) A girl with acute dorsal disease was seven-eighths of an inch longer when lying down. (5) A girl with high dorsal disease was seven-eighths of an inch longer when lying down.

These experiments show that a child with Pott's disease is from one-quarter to seven-eighths of an inch longer in recumbency than in standing. This difference can be accounted for by the change in the curves of the spine.

An experiment was then undertaken to see if the plaster jacket caused lengthening of the child, and if so, under what circumstances. (1) Jacket applied by suspension. The immediate effect was an increase in the length of the child five-eighths of an inch over the standing position, but at the end of twenty minutes the child had shortened three-eighths of an inch, and at the end of thirty minutes was back to one-eighth of an inch of the height when standing with no apparatus. In other words, the application of a plaster jacket lengthened the child only one-eighth of an inch. It may be mentioned incidentally that the child when lying on its back was one-half of an inch longer than when it was standing up with a properly applied plaster jacket. (2) A jacket was applied to a child, with the effect of immediately

lengthening it over the standing position. At the end of twenty minutes, the child was at the same height as when standing without the jacket on, and was seven-eighths of an inch shorter than

FIG. 3.

when lying on the back in bed. The jacket was applied by suspension. (3) A jacket was applied by the hammock method: Standing without support, 3 feet $2\frac{3}{4}$ inches; ten minutes after appli-

cation of jacket, 3 feet $2\frac{3}{4}$ inches; twenty minutes after application of jacket, 3 feet $2\frac{1}{2}$ inches. (4) Jacket applied by the hammock: Standing without jacket, height 3 feet $4\frac{5}{8}$ inches; immediately after application of jacket, 3 feet $4\frac{3}{4}$ inches; ten minutes after application of jacket, 3 feet $4\frac{5}{8}$ inches.

In no one of the four experiments was the child substantially longer after the careful application of the jacket than when standing unsupported, and in no case as long as when lying down without apparatus. The column is longest and the spine consequently straightest when the child is suspended or has traction applied in bed to the legs and head. A boy with mid-dorsal disease, not very acute, was an inch longer in bed with traction than when he stood up. A girl with high dorsal disease and paralysis was lengthened three-eighths of an inch by traction over her length when lying quietly in bed. The spine is in its second best position when the child lies in bed without traction. The spine is shortest, and consequently in its worst position when standing, and the application of a jacket has not, in any case observed by the writer, been found to produce any permanent increase in height, except in one case where it lengthened the child one-eighth of an inch over the position without a jacket. The same may be said of the application of the antero-posterior brace. Recumbency, on the other hand, does produce such an increase in length. To the writer's mind, the case is clear. Recumbency with traction is the best available treatment if we regard only the position of the

spine. Simple recumbency is the next best. Treatment by ambulatory measures is the worst. These are demonstrated by the length of the child under these various conditions.

Recumbency.—With regard to the treatment by recumbency I am as far as any one from wishing to advocate unnecessary recumbency, but I wish to go on record as advocating, in general, during the acute stage of Pott's disease, recumbency on a frame for the greater part of the time, varied by short periods of going about protected by the most available brace or jacket. During the painful stage I believe that recumbency should be continuous. The beneficial effect of recumbency must be familiar to every orthopedic surgeon, who must often notice the improved appetite, the increase in flesh, and the diminished fever, when a child with acute Pott's disease is put to bed.

In the use of apparatus it should be remembered that it is all necessarily imperfect from a mechanical point of view, and does not afford complete support, and that traumatism to the spine must result from the use of the jacket or the brace. The more complete and efficient the apparatus, the less the traumatism.

Such are the scattered facts that I have brought together for your attention. Pott's disease, it seems to me, is a very grave affection, and in advocating its treatment by recumbency, rather than by ambulatory measures, during the acute stage, I am speaking of what I believe to be the very best treatment. Other modes of treatment are no doubt excellent, but when one wishes to secure

the very best result, it seems to me that, having recognized that apparatus is intrinsically imperfect, and necessarily so, to accomplish the purpose for which it is intended, it is incumbent upon the surgeon either to insist upon this treatment by recumbency or to transfer the responsibility of ambulatory treatment to the parents. The use of apparatus, it seems to me, should be during the acute stage, to vary the monotony of recumbency. That recumbency should be carried out by having the child lie upon its back upon a frame. The addition of traction to the legs and head I believe to be of benefit, and that it hastens recovery by quieting muscular spasm and improving the position of the spine. I believe that it should be used in all cases of paralysis due to Pott's disease.

With regard to apparatus, whether we use it in the way that I have advocated or as the sole means of treatment, it seems to me that we should remember that apparatus is necessarily mechanically inefficient to solve the problem which it undertakes. If apparatus is used these points should be remembered: the position of the superincumbent weight should be as far back as possible, and the higher the backward pull comes, whether a jacket or a brace is used, the less force is required.

Whether we wish to follow the best treatment or not may be a question, but it is the writer's belief that treatment by recumbency, so prevalent in the early days of orthopedic surgery, will come again to the front if the real value of supporting apparatus is studied.